



## General Information

- *Clostridium difficile* is a Gram positive, strictly anaerobic, spore-forming bacterium that can be found in the intestinal tract of humans and many animal species, including companion animals, farm animals and wildlife.
- *Clostridium difficile* is an important cause of disease in many of these species, including people.
- Strains of *C. difficile* can produce one or more toxins (toxin A, toxin B, CDT/binary toxin). Strains that do not possess the genes for any toxins do not cause disease.
- This bacterium cannot grow in an aerobic environment, but the bacterial spores are extremely hardy and can survive in the environment for a long time, even for years.
- In people, *C. difficile* is most common in the elderly, hospital inpatients and individuals on antimicrobial therapy.
- The strains of *C. difficile* that infect pets are often the same as those that infect people, but it remains unclear if animals can transmit *C. difficile* to humans.



## Prevalence & Risk Factors

### Humans

- In developed countries, *C. difficile* is the leading cause of infectious hospital-associated diarrhea in adults, and accounts for 15-25% of cases of antimicrobial-associated diarrhea. The primary risk factor for disease is treatment with antimicrobials.
- Old age, antineoplastic chemotherapy, extended hospitalization, acid-suppressive therapy for gastric ulcers, enemas, nasogastric intubation, antiperistaltic drug therapy and gastrointestinal surgery are also associated with disease due to *C. difficile* infection (CDI).
- Recently, severe disease due to CDI has also been reported in otherwise healthy individuals in the community.



### Animals

- A small percentage of healthy dogs and cats (0-4%) carry *C. difficile* in their intestinal tract. Carriage rates tend to be higher (up to 30%) in puppies, kittens, animals in breeding colonies and dogs that visit human hospitals.
- Most often the bacterium never causes any illness in these animals.
- Treatment with antimicrobials increases the likelihood that a dog is shedding *C. difficile* in its feces. Contact with children has also been implicated as a risk factor for *C. difficile* shedding in dogs.

## Habitat & Environmental Survival

The main reservoir of *C. difficile* is the intestinal tract of various animal species. The spores of the bacterium can survive very well in the environment and are resistant to most disinfectants. Nonetheless, a 1:10 solution of household bleach can effectively eliminate spores if all visible organic debris is removed beforehand and adequate contact time (10-15 minutes) is allowed. Oxidizing agents (e.g. peroxygen disinfectants) may also be effective.

## Transmission of *C. difficile*

- *Clostridium difficile*, like most other enteric pathogens, is transmitted by the fecal-oral route. Human patients in hospitals can be infected with *C. difficile* from environmental surfaces, shared equipment, hands of hospital personnel and infected roommates.
- It is unclear if *C. difficile* can be transmitted from pets to people. The types of *C. difficile* found in pets are often the same as those found in people, including the epidemic strain ribotype 027/NAP1. This suggests that *C. difficile* could potentially be transmitted between people and animals, but there is still no conclusive evidence. It is prudent to err on the side of caution and consider *C. difficile* transmissible between pets and people until proven otherwise.





## Symptoms and Signs

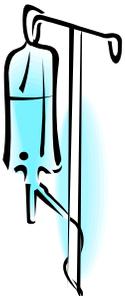
**Humans:** In people, CDI (also known as *C. difficile*-associated disease [CDAD]) can range from inapparent to rapidly fatal. Diarrhea is the primary clinical sign, and can range from mild and self-limiting to very severe. Complications such as pseudomembranous colitis, toxic megacolon and intestinal perforation can occur. Complication and death rates seem to be increasing in people.

**Animals:** The role of *C. difficile* as a cause of disease in dogs and cats is not clear, as the vast majority of these animals with *C. difficile* in their intestinal tracts do not become ill. However, an association between *C. difficile* and diarrhea has been made in dogs, and there is one report implicating *C. difficile* as a cause of diarrhea in cats. In most of these cases the diarrhea is mild, and clinically cannot be differentiated from diarrhea due to other common causes. Occasionally, severe diarrhea may occur, and it has been suggested that *C. difficile* may be a cause of hemorrhagic colitis in animals.

## Diagnosis of *C. difficile*

Testing for *C. difficile* infection in humans and companion animals with acute diarrhea is reasonable, even in the absence of a history of antimicrobial treatment or hospitalization. The optimal means of diagnosis is currently unclear as there are limitations to all available tests.

- **Toxin tests:** Detection of *C. difficile* toxins A and/or B in diarrheic feces is the standard for diagnosis, for which enzyme-linked immunosorbent assays (ELISAs) are commonly used. Testing is readily available through human medical diagnostic laboratories, but while these tests have good sensitivity and specificity in humans, they do not perform as well in dogs. Antigen ELISAs are used concurrently in some cases to detect the organism itself, which helps support for the diagnosis, but antigen ELISA alone is not diagnostic because it also detects non-toxigenic strains and non-pathogenic intestinal colonization.
- **Fecal culture:** Fecal culture for *C. difficile* is not routinely recommended, as it is difficult to do, has a slow turnaround time, and is of limited availability. Furthermore, as with the antigen ELISA, simply detecting *C. difficile* in the feces does not mean that it is causing disease, as strains that cannot produce toxins are not pathogenic, and healthy humans, dogs and cats can also shed toxigenic *C. difficile*. Fecal smears are useless for diagnosis of *C. difficile* infection.
- **Polymerase chain reaction (PCR):** Use of PCR to detect *C. difficile* toxin genes is being evaluated as a more rapid and sensitive test for high-risk human populations (i.e. hospitalized individuals). The usefulness of such an assay in community settings is unclear. These assays have not been validated for use in companion animals. However, even detection of *C. difficile* strains capable of producing toxins does not mean that the bacteria are producing toxins and causing disease. Therefore toxin detection itself remains the key.



## Treatment of *C. difficile* Infection (CDI)

**Animals:** Some (if not most) cases of CDI in companion animals are self-limiting, and require only supportive care. Objective information on specific treatment of CDI in animals is not available, but subjectively, metronidazole (10-15 mg/kg PO q8-12h) appears to be an effective therapy in dogs and cats. Intravenous metronidazole (15 mg/kg q12h) can be used if the animal cannot tolerate oral medication. Metronidazole resistance has not been identified in *C. difficile* from dogs or cats. Adjunctive therapies, such as dietary changes, intestinal adsorbents and probiotics, have been tried but their efficacy is unclear. There is no vaccine available for *C. difficile* for any species.

**Humans:** Metronidazole has been the mainstay of antimicrobial therapy for CDI, but there are developing concerns about resistance to this drug in humans. Cessation of inciting antimicrobial therapy is important, if possible, as is general supportive care. In severe cases, colectomy may be required. Probiotics are not considered effective.

## Infection Control For Pets Carrying *C. difficile*

**Hand Hygiene:** Anyone handling the animal should wash their hands immediately afterwards with soap and running water. Alcohol-based hand sanitizers are unlikely to be effective against clostridial spores, so ideally soap and water must be used.

**In-Clinic Precautions:** All animals with acute diarrhea of unknown etiology should be considered infectious, because there are numerous infectious pathogens, including *C. difficile*, that could be the cause.





- Animals with acute diarrhea should be admitted directly to isolation or an examination room, and should not have contact with other animals in the reception area.
- Contact precautions (i.e. examination gloves and a gown or dedicated laboratory coat) should be used when handling affected animals.
- Hands should be washed with antibacterial soap and water after contact with the patient or areas that may have become contaminated, even if gloves are worn.
- Contaminated surfaces must be thoroughly cleaned to remove all visible organic debris prior to applying disinfectant. Use a 1:10 solution of bleach, ensuring that adequate contact time (at least 10-15 minutes) is permitted. Oxidizing agents (e.g. peroxygen disinfectants) may also be effective against clostridial spores.
- It is not known how much of a risk an infected animal is to other animals. It is prudent to keep pets diagnosed with *C. difficile* isolated from other pets while in the clinic until the diarrhea has resolved.

### Considerations For Therapy Animals

Visiting healthcare facilities has been shown to be a risk factor for *C. difficile* shedding in dogs. However, it is unclear whether “therapy pets” involved in healthcare visitation have an increased risk of disease.

- Guidelines have been developed to reduce the risk of pets acquiring infectious diseases in hospitals. Owners involved in these programs should ensure that they follow these guidelines. In particular:
  - Dogs should never be allowed to drink out of the toilet when in a healthcare facility.
  - Dogs should not be fed treats by patients.
- **Testing or treating clinically normal animals for *C. difficile* is not indicated**, but *C. difficile* should be considered in these animals if they develop diarrhea.

### Pet owners diagnosed with CDI

Owners diagnosed with CDI should be told to wash their hands thoroughly after using the washroom. Their pet(s) should also be prevented from drinking from the toilet. There is currently no evidence that testing pets for *C. difficile* in the absence of strain characterization is useful if an owner is diagnosed with CDI.

### Zoonotic Disease Risk

The zoonotic risk to the general population posed by *C. difficile* in house pets such as dogs and cats is:

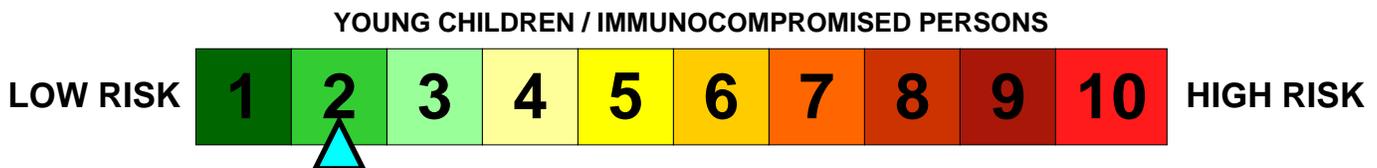


**Individuals with compromised immune systems** (e.g. HIV/AIDS, transplant and cancer patients) are more susceptible to many kinds of infections, including those which may be transmitted by pets. While these individuals are not advised to get rid of their pets, precautions should be taken to reduce the frequency of contacts that could result in pathogen transmission (e.g. avoiding contact with any animal feces), as well as the ability of infectious agents to survive in the household (e.g. prompt and thorough disinfection of potentially contaminated surfaces).

**Infants and young children** (less than 5 years old) are more likely than adults to extensively handle animals if given the opportunity, more likely to touch their faces or mouths, and less likely to wash their hands after handling an animal. Children may “snuggle” with pets; this very close contact can increase the risk of disease transmission.

- Young children should be supervised when playing with animals, and an adult should ensure that they wash their hands afterwards, and especially prior to handling food. Older children should be taught to do the same.
- It is important to note that **infants less than 12 months of age are not affected** by *C. difficile*, possibly because they lack the cellular receptor for the toxin.

For these groups, the zoonotic risk posed by *C. difficile* in house pets such as dogs and cats is likely:





## Additional Information

- Weese JS, Armstrong J. Outbreak of *Clostridium difficile* -associated disease in a small animal veterinary teaching hospital. J Vet Intern Med. 2003;17:813-816.
- Cave NJ, Marks SL, Kass PH, et al. Evaluation of a routine diagnostic fecal panel for dogs with diarrhea. J Am Vet Med Assoc. 2002;221:52-59.
- Clooten J, Kruth S, Arroyo L, Weese JS. Prevalence and risk factors for *Clostridium difficile* colonization in dogs and cats hospitalized in an intensive care unit. Vet Microbiol. 2008;129:209-214.
- Lefebvre SL, Golab GC, Christensen E, et al. Guidelines for animal-assisted interventions in health care facilities. Am J Infect Control. 2008;36:78-85.

